

2009 Monitoring Summary

Herrin Creek at New Cut Road (Morgan County; 34.378/-87.022)

BACKGROUND

The 6.2 mile segment of Herrin Creek from Crowabout Creek to its source was placed on Alabama's 1998 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its *Fish & Wildlife (F&W)* water use classification criteria. The reach was listed for impairments caused by ammonia, nutrients, siltation, and organic enrichment/low dissolved oxygen concentrations (OE/DO) from pasture grazing.

The Alabama Department of Environmental Management (ADEM) developed a Total Maximum Daily Load (TMDL) to decrease the sediment load of 22 stream segments within the Lower Tennessee River Basin, including Herrin Creek. A second TMDL was developed to address the ammonia, nutrient, and OE/DO impairments in Herrin Creek and 16 other impaired stream segments within the Flint Creek watershed. Both TMDLs were approved by US Environmental Protection Agency Region 4 (USEPA) in 2003.

In 2006, a watershed management plan (WMP) was developed to help address the agricultural sources of ammonia, nutrients, siltation and organic enrichment identified in the two TMDLs. The WMP was implemented between January of 2006 and January of 2008. The plan was funded in part using a Clean Water Act (CWA) §319(h) nonpoint source grant provided by USEPA through ADEM's §319 grant program. As part of the WMP, riparian forest buffers were planted around two areas within the Herrin Creek watershed (Figure 1a). Figures 2-4 show stream reaches within the Herrin Creek watershed in 2006, when planting of the riparian forest buffer began, and in 2011, three years after the project was fully implemented.

In 2009, the ADEM conducted habitat, macroinvertebrate and intensive water quality sampling in Herrin Creek at HERM-1 to document current water quality conditions and to evaluate the effectiveness of BMPs implemented in the Herrin Creek watershed. The site is directly downstream of all BMPs, but a forest riparian buffer was not planted along this reach. The site is approximately 2.7 stream miles downstream of the forest buffer planted along the mainstream of Herrin Creek.

Assessments were conducted at McDaniel Creek at MCDL-360 and Indian Camp Creek at INCL-1 during 2009 for comparison. McDaniel Creek at MCDL-360 is similar to Herrin Creek at HERM-1 in drainage area, gradient, flow characteristics, and land cover (Table 1; Figure 1b). Additionally, a 3.9 mile segment of McDaniel Creek from West Flint Creek to AL Hwy 36 was placed on Alabama's 1998 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its *F&W* water use classification criteria. It was listed for impairments caused by siltation and OE/DO issues from agricultural sources. These similarities suggest that the 2009 sampling results from McDaniel Creek at MCDL-360 are representative of pre-BMP conditions that would be expected in Herrin Creek at HERM-1.

Indian Camp Creek at INCL-1 is a similarly-sized, least-impaired reference reach located within the Interior Plateau (Table 1; Figure 1c).

WATERSHED CHARACTERISTICS

Table 1 and Figures 1a-1c summarize land cover within the Herrin Creek, McDaniel Creek, and Indian Camp Creek watersheds, based on the 2006 National Land Cover Datasets (NLCD).

All three watersheds are located within the Interior Plateau ecoregion (71). They range in size from 5.7 to 11.1 mi². Herrin and McDaniel Creek are characterized by very similar flow regimes and gradient. Percent forest and development were highest in the Indian Camp Creek watershed. Percent pasture was highest in Herrin Creek.

Table 1. Comparison of land cover among Herrin Creek at HERM-1, McDaniel Creek at MCDL-360, and Indian Camp Creek at INCL-1 based on the 2006 National Land Cover Datasets (NLCD).

Watershed Characteristics				
		HERM-1	MCDL-360	INCL-1
Ecoregion		71g	71g	71f
Drainage area (mi²)		5.7	11.1	8.4
Gradient (ft/0.5 mi)		9.4	8.1	14.2
Flow Duration (Q cfs)	Jan-Mar	0.5	0.9	4.5
	Apr-Jun	0.1	0.2	3.5
	Jul-Sep	0.0	0.0	2.1
	Oct-Dec	0.0	0.0	2.5
% Landuse				
Open water		<1	0	0
Wetland	Total	3	5	3
	Woody	1	3	<1
	Herbaceous	2	2	3
Forest	Total	35	32	45
	Deciduous	23	18	40
	Evergreen	6	7	3
	Mixed	7	8	2
Other grasses/Shrub/scrub		2	6	10
Pasture/hay		51	46	31
Cultivated crops		1	6	4
Development		4	4	7

REACH CHARACTERISTICS

ADEM completed general observations (Table 2) and habitat assessments (Table 3) during the 2009 macroinvertebrate assessments. In comparison with reference reaches in the same ecoregion, they give an indication of the physical condition of the site and the quality and availability of habitat. Stream geomorphology and substrate composition varied among the three stream reaches. Herrin Creek at HERM-1 was a glide-pool, sandy-bottomed stream reach. Very little riffle habitat was present within McDaniel Creek at MCDL-360, but bottom substrate at this site was dominated by clay. Despite these differences, the overall quality and availability of habitat was comparable between the two stream reaches. The slightly higher gradient of Indian Camp Creek at INCL-1 translated into more riffle habitat and a greater percentage of large, stable substrates for macroinvertebrate colonization.

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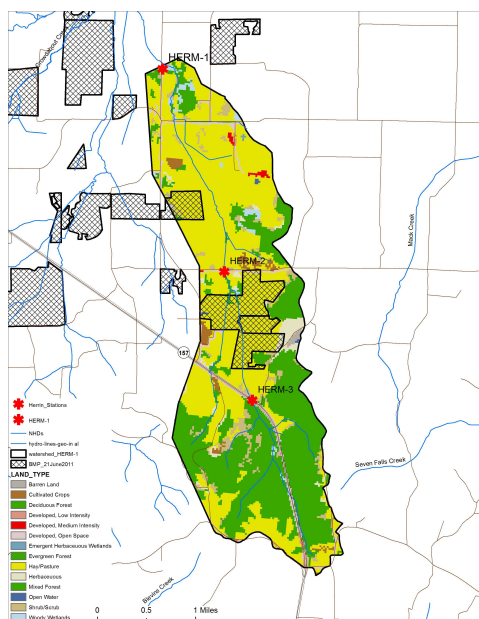


Figure 1a. Land cover within the HERM-1 watershed based 2006 NLCD. The location of BMPs installed 2006-2011 is also shown.

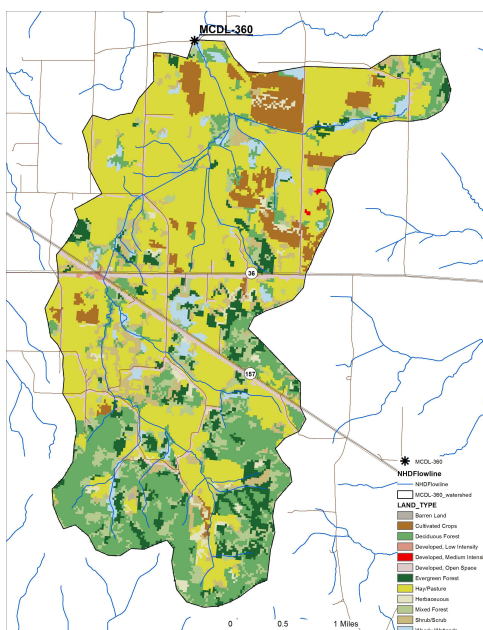


Figure 1b. Land cover within the MCDL-360 watershed based 2006 NLCD. Although landuse is similar to HERM-1, BMPs have not been installed in this watershed.

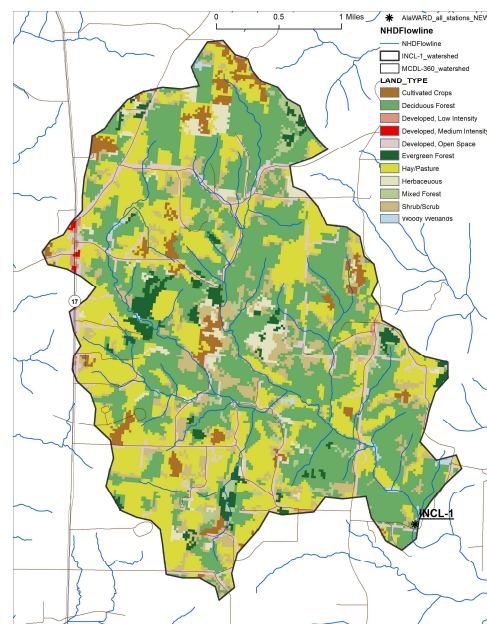


Figure 1c. Land cover within the INCL-1 watershed based on the 2006 NLCD.

Table 2. Summary of physical characteristics observed at HERM-1, MCDL-360, and INCL-1.

Physical Characteristics		HERM-1	MCDL-360	INCL-1
Date (m/d/yyyy)		6/2/2009	6/30/2009	7/1/2009
Width (ft)		12.0	12.0	20.0
Canopy Cover		Mostly shaded	Mostly shaded	50/50
Depth (ft)	Riffle	0.0	0.3	0.5
	Run	0.8	1.0	2.0
	Pool	1.5	1.5	3.0
Depth (%)	Riffle	0	5	10
	Run	85	75	70
	Pool	15	20	20
% of Substrate	Bedrock	0	2	20
	Boulder	0	1	20
	Cobble	0	2	15
	Gravel	15	5	20
	Sand	60	5	15
	Silt	10	5	0
	Organic Matter	13	5	8
	Clay	2	75	2

Table 3. Results of habitat assessments conducted at HERM-1, MCDL-360, and INCL-1.

% Maximum Score		HERM-1	MCDL-360	INCL-1
Habitat Assessment		6/2/2009	6/30/2009	7/1/2009
Date (m/d/yyyy)		6/2/2009	6/30/2009	7/1/2009
Instream habitat quality		46	50	87
Sediment deposition		59	58	78
Sinuosity		55	83	85
Bank and vegetative stability		35	40	65
Riparian buffer		48	48	68
Habitat assessment score		105	130	185
% Maximum score		48	54	77
Habitat Assessment Rating		Marginal	Marginal	Optimal

MACROINVERTEBRATE BIOASSESSMENTS

ADEM sampled the benthic macroinvertebrate community using ADEM's Intensive Multi-habitat Bioassessment Methodology (WMB-I) at all three stations in 2009 (Table 4). The WMB-I uses measures of taxonomic richness, community composition, and community tolerance to assess the overall health of the macroinvertebrate community.

Better biological community conditions at INCL-1 were evidenced by the highest number of EPT genera, the highest number of clinger taxa, and the highest Becks community tolerance index score. Metric results suggested similar macroinvertebrate community conditions at HERM-1 and MCDL-360.

Table 4. Results of macroinvertebrate bioassessments of Herrin Creek at HERM-1, McDaniel Creek at MCDL-360, and Indian Camp Creek at INCL-1.

Macroinvertebrate Assessment Results		HERM-1	MCDL-360	INCL-1
Date (m/d/yyyy)		6/2/2009	6/30/2009	7/1/2009
Taxa richness measures				
# EPT genera		7	9	19
Taxonomic composition measures				
% Non-insect taxa		20	19	14
% Dominant taxon		27	12	23
Functional composition measures				
# Clinger taxa				
Tolerance measures				
Beck's community tolerance index		6	4	17
% Nutrient tolerant organisms		42	27	44



Figure 2a. Site in the Herrin Creek watershed in 2006.



Figure 2b. Same location in 2011 after best management practices were implemented.



Figure 3a. Site in the Herrin Creek watershed in 2006.



Figure 3b. Same location in 2011 after best management practices were implemented.



Figure 4a. Site in Herrin Creek watershed in 2006.



Figure 4b. Same location in 2011 after best management practices were implemented.

WATER CHEMISTRY

Table 5 summarizes water quality data collected at the three stations in Herrin Creek in 2009 after the implementation of the WMP (Figure 1a). Herrin Creek at HERM-2 is located directly downstream of the riparian forest buffer planted on the mainstem of Herrin Creek. Herrin Creek at HERM-3 is located upstream of all BMPs. The 2006 NLCD show this area to be primarily forested. Table 5 also includes 2009 data for McDaniel Creek at MCDL-360, and Indian Camp Creek at INCL-1.

In situ measurements and water samples were collected monthly, March through October at all stations. However, nutrient samples collected March-July (ammonia nitrogen, total Kjeldahl nitrogen (TKN), and total phosphorus) were excluded from analyses because they did not meet ADEM's laboratory quality control requirements.

In 2009, all parameters at Herrin Creek were meeting *F&W* water use classification criteria. Water quality data did not indicate any dissolved oxygen violations within Herrin or McDaniel Creek.

Turbidity was higher in HERM-2 and HERM-3 than at HERM-1, or the other two stream reaches. Conductivity and total dissolved solids were highest at MCDL-360, possibly due in part to the higher percent clay substrate.

Ammonia nitrogen, nitrate-nitrite nitrogen, and CBOD-5 concentrations were lower in Herrin Creek and comparable to reference conditions. Also, ammonia-nitrogen concentrations at HERM-2 and HERM-3 were below minimum detection limits the entire 2009 sampling season. However, total Kjeldahl nitrogen and total phosphorus were higher in Herrin Creek than in McDaniel Creek.

SUMMARY

The 6.2 mile segment of Herrin Creek from Crowabout Creek to its source was placed on Alabama's 1998 CWA §303(d) list of impaired waters for not meeting its *F&W* water use classification criteria. The reach was listed for impairments caused by ammonia, nutrients, siltation, and organic enrichment/low dissolved oxygen (OE/DO) from pasture grazing.

Two separate TMDLs were developed to decrease siltation and organic enrichment within Herrin Creek and other streams within the Tennessee River basin. Riparian forest buffers and other BMPs were implemented between January of 2006 and January of 2008 to address the agricultural sources of siltation, pathogens, and organic enrichment identified in the two TMDLs.

In 2009, the ADEM conducted habitat and macroinvertebrate assessments and intensive water quality sampling in Herrin Creek to document current water quality conditions and to evaluate the effectiveness of BMPs implemented in the Herrin Creek watershed. Ammonia nitrogen, nitrate-nitrite nitrogen, and CBOD-5 concentrations were lower in Herrin Creek and comparable to reference conditions. However, it appears siltation may still be a problem in the reach as turbidity values were high.

Photographs taken in 2006 and 2011 have documented improved conditions throughout the watershed. Although among the most effective BMPs at controlling erosion, forest riparian buffers are also among the slowest to become established and fully effective. The 2009 assessments were conducted only 17 months after the WMP was fully implemented. Additionally, HERM-2, the site closest to the newly forested areas could not be sampled during 2009. HERM-1 is located approximately 2.7 stream miles downstream of the forested buffers. Monitoring and BMP implementation should continue to document trends in habitat, biological and water quality conditions as the riparian forests and other BMPs become more established.

Table 5. Summary of water quality data collected by ADEM in 2009. McDaniel Creek at MCDL-360 represents pre-BMP conditions of Herrin Creek, and Indian Camp Creek at INCL-1 is a least-impaired reference reach located in the Interior Plateau ecoregion.

Parameter	Basis of Comparison	HERM-1	HERM-2	HERM-3	MCDL-360	INCL-1
Temperature (°C)	Max	24.3	24.2	22	23.6	22.4
Turbidity (NTU)	Max	114	794	549	50.1	9.5
Total Dissolved Solids (mg/L)	Median	171	180	120	192	67.5
Total Suspended Solids (mg/L)	Median	12	6	3	7	2.5
Specific Conductance (µmhos)	Median	255	256	198	326.6	102.5
Stream Flow (cfs)	Min	0.5	0.3	0.5	0.4	4
Dissolved Oxygen (mg/L)	Min	5.5	6.8	7.4	5.1	7.9
Ammonia Nitrogen (mg/L)	Median	0.003	0.003	0.003	0.017	0.003
Nitrate+Nitrite Nitrogen (mg/L)	Median	0.321	0.438	0.378	0.572	0.38
Total Kjeldahl Nitrogen (mg/L)	Median	1.03	0.61	0.299	0.504	0.044
Total Phosphorus (mg/L)	Median	0.156	0.078	0.023	0.076	0.015
CBOD-5 (mg/L)	Median	0.5	0.5	0.5	1	0.5